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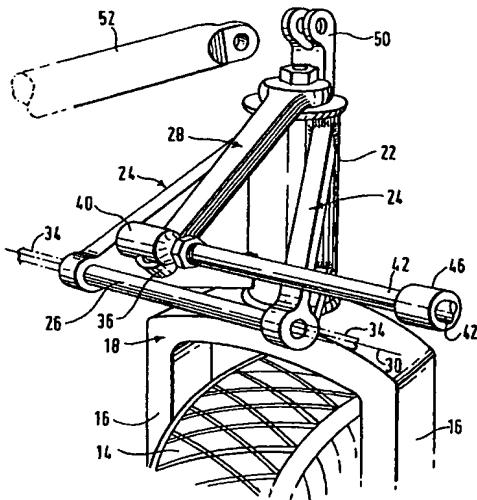
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(54) Title: A RETRACTABLE ROAD WHEEL AND STEERING ARRANGEMENT FOR AN AMPHIBIOUS VEHICLE



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(57) Abstract: The arrangement has at least one retractable steered wheel, and comprises : at least one wheel rotatably mounted on a steerable leg member (18); said leg member (18) being pivotably mounted on pivot means which is pivotable around a substantially horizontal axis (30) relative to a hull of said amphibious vehicle, said axis also being transverse to a longitudinal direction of travel of said hull; a steering arm member (28) operably connected to said steerable leg member (18); means to raise said wheel by pivoting said wheel about said horizontal axis; wherein an end of said steering arm member remote from said steerable leg member is closely adjacent said horizontal axis and operably connected to steering arm moving means.



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**A RETRACTABLE ROAD WHEEL AND STEERING ARRANGEMENT FOR AN AMPHIBIOUS VEHICLE**

The present invention relates to a retractable wheel  
5 mounting and steering arrangement for an amphibious vehicle.

For amphibious vehicles wherein the road wheels are retractable so as to improve the hydrodynamics of the  
10 vehicle when in water, it would be advantageous if the front steering wheel or wheels could be retracted without the need to disconnect or significantly misalign a steering mechanism. Furthermore, it would also be advantageous in cost terms if such steering mechanisms  
15 were simple and did not rely on complex systems of interconnected levers and joints.

According to a first aspect of the present invention there is provided a steering and wheel mounting  
20 arrangement for an amphibious vehicle having at least one retractable steered wheel, said steering and wheel mounting arrangement comprising: said at least one wheel rotatably mounted on a steerable leg member; said leg member being pivotably mounted on pivot means which is  
25 pivotable around a substantially horizontal axis relative to a hull of said amphibious vehicle; a steering arm member operably connected to said steerable leg member; means to raise said wheel by pivoting about said axis; wherein an end of said steering arm member remote from  
30 said steerable leg member is closely adjacent said horizontal axis and operably connected to steering arm moving means.

According to a second aspect of the present invention, there is provided an amphibious vehicle having the wheel mounting and steering arrangement of the first aspect of the present invention.

5

The pivot means may include a bracket member on which the steerable leg member is mounted.

Said axis may be transverse or generally parallel to a  
10 longitudinal direction of travel of said hull. Thus, the wheel may be raised by the mounting and steering arrangement being tipped backwards about the axis. However, the wheel mounting and steering arrangement may, for example, be raised by being rotated about the axis  
15 which also extends in a longitudinal direction with respect to the hull.

One embodiment of an amphibious vehicle of the present invention may comprise a relatively small vehicle capable  
20 of accommodating only a few people. The vehicle may not possess suspension in terms of separate springs and shock absorbers for example but may depend upon relatively large, low-pressure tyres for springing and shock absorbing properties. Furthermore, the vehicle may have  
25 only a single steerable wheel.

However, the provision of separate conventional suspension members and/or two steerable front wheels is not precluded by the arrangement of the present  
30 invention. Suspension members may be interposed between the wheel mounting and steering arrangement described and the vehicle hull.

The end of the steering arm remote from the wheel  
35 mounting leg is positioned such that it is closely

- adjacent the horizontal axis about which the bracket on which the steerable leg member is mounted rotates. Rotation of the bracket and leg raises the wheel out of the water for example. However, because the end of the
- 5 steering arm is adjacent the rotation axis, the degree of physical translation is very small and can be accommodated by the steering arm moving means. The steering arm moving means may comprise a cable or linkage operably connected to a tiller or steering wheel for
- 10 example. The steering arm moving means is capable of accommodating the degree of movement inherent on raising the wheel or wheels. However, the geometry of the steering arrangement according to the present invention is such that even with the wheel in its raised position,
- 15 the steering arm is able to be moved through its full arc of movement by the steering arm moving means. Thus, if the road wheel steering linkage is also connected to water guidance means such as a rudder or hydrojet for example, directional control of the vehicle can still be
- 20 effected by the normal steering arrangement without disconnection of the steering arm moving means from the road wheel or by the need for alternative or duplicated steering linkages to the water guidance means.
- 25 In order that the present invention may be more fully understood an example will now be described by way of illustration only with reference to the accompanying drawings, of which:
- 30 Figure 1 shows a side elevation of the principal components of a wheel mounting and steering arrangement according to the present invention in raised and in road-going positions; and

Figure 2 which shows a perspective view of the arrangement of Figure 1 in the road-going position.

Referring now to the drawings and where the same features  
5 are denoted by common reference numerals. A wheel  
mounting and steering arrangement in an amphibious  
vehicle hull is denoted generally at 10, the hull being  
denoted only by its lower surface such as a chine 12. In  
this embodiment there is a single steerable and  
10 retractable front wheel 14 rotatably mounted between the  
forks 16 of a steerable leg member 18. The leg member 18  
has a pivot shaft 20 which is pivotably mounted in a  
tubular headstock 22 to which is strongly mounted a pair  
15 of diverging triangular support brackets 24. Each support  
bracket 24 has a mounting point at its apex to which a  
tie tube 26 is joined, the tube 26 not only bracing the  
support brackets 24 but importantly provides a main pivot  
axis 30 about which the wheel and support assembly is  
retracted. A steering arm 28 is fixed to the steering leg  
20 shaft 20 so that movement thereof causes turning of the  
wheel 14 when in the road-going position and in the  
retracted position. The support brackets 24 are pivotable  
about the horizontal axis 30 (the term "horizontal" being  
defined with reference to the hull 12), the axis 30 also  
25 being transverse to a direction of travel of the hull 12  
denoted by arrow 32. The brackets 24 and headstock  
arrangement are pivotably mounted upon a support shaft 34  
(shown in dashed lines) which is fixed to strong supports  
(not shown) on the hull 12 and passing through the tie  
30 tube 26. The end 36 of the steering arm 28 is adjacent  
the axis 30/tube 26 and has a joint such as a ball joint  
40 fixed thereto and which is itself connected to a  
steering rod 42 (or cable such as a flexible Bowden-type  
cable sliding in an outer sheath). The rod 42 has a  
35 rotatable joint 46 to accommodate rotation of the rod 42

during retraction of the wheel, the joint 46 being able to accommodate axial thrust. The steering rod 42 is connected at its end remote from the ball joint 40 to a lever or bellcrank (not shown) which is itself operably  
5 connected to a primary steering member such as a tiller or steering wheel (not shown) which is directly controlled by the driver. The wheel steering mechanism is also connected by a linkage (not shown) to water guidance means such as a rudder or hydrojet (not shown) which are  
10 also moved by the primary steering member. A further bracket 50 is fixed to the headstock 22 and to which is connected means 52 to enable the whole wheel mounting and steering arrangement 10 to be tipped backwards about the axis 30 in order to retract the wheel 14. The retracted  
15 position is shown in Figure 1 in dashed lines. The means 52 may comprise any suitable means and may include a hydraulic cylinder and ram or a mechanical strut arrangement, for example.

20 From Figures 1 and 2 it may be seen that the end 36 of the steering arm 28 is adjacent the main pivot axis 30 thus, when the arrangement 10 is retracted, the actual displacement of the steering arm end 36 and joint 40 is relatively very small, rotational displacement being  
25 accommodated by the thrust bearing 46. Furthermore, since the steering rod 42 (or cable) is mounted to move with the support frames 24 there is little relative translational displacement of the end of the steering arm moving means 42 and steering arm 28. The arrangement  
30 shown in Figures 1 and 2 show that it is possible to have strong and simple steering arrangement comprising rods or linkages or cables attached to a retractable wheel. The close proximity of the steering arm and ball joint 40 to the main pivot axis 30 results in small angular changes  
35 which are accommodated by the steering rods or cable 42

through its arc of movement during retraction of the wheel. An important feature of the present invention is that the steering mechanism continues to be able to steer the wheel even in the retracted position thus, upon the 5 amphibious vehicle becoming water-borne and the wheel being retracted, the primary steering member operated by the driver, e.g. a steering wheel or tiller, is still connected to and operates the water guidance means such as a rudder or hydrojet, without the need to disconnect the 10 road-going wheel or road steering. Thus, the arrangement of the present invention is simple and convenient in use.

Figure 1 shows the wheel in its road-going position in solid lines and in the retracted position in dashed lines.

15

Although the example describes a single steerable wheel 14, there may be two steerable front wheels. A suitable arrangement may comprises two sets of the assemblies 10 described above with steering arms 28 linked together by a 20 tie rod but essentially operated in the same way as described with reference to Figures 1 and 2 by a single steering arm moving means 42.

In the example springing and shock absorbing is effected 25 in the road-going mode by bulbous low-pressure "floatation" tyres, however, conventional suspension members such as springs and shock absorbers may be employed if desired. For example, conventional suspension members may be interposed between the leg member 18 and 30 the tubular headstock 22. In which case a square section (or other than round) sliding pillar may be incorporated in such a way that the steering arm 28 remains in the same close proximity to the support brackets 24 and the main pivot axis 30, the headstock 22 and steering being 35 unaffected by the suspension.

**CLAIMS**

1. A steering and wheel mounting arrangement for an amphibious vehicle having at least one retractable steered wheel, said steering and wheel mounting arrangement comprising: said at least one wheel rotatably mounted on a steerable leg member; said leg member being pivotably mounted on pivot means which is pivotable around a substantially horizontal axis relative to a hull of said amphibious vehicle; a steering arm member operably connected to said steerable leg member; means to raise said wheel by pivoting said wheel about said horizontal axis; wherein an end of said steering arm member remote from said steerable leg member is closely adjacent said horizontal axis and operably connected to steering arm moving means.
2. An arrangement according to claim 1 wherein the steering arm moving means comprises a cable or rod linkage.
3. An arrangement according to claim 2 wherein the cable is a flexible Bowden-type cable.
4. An arrangement according to claim 2 wherein the rod linkage is connected to the steering arm by a ball-joint or universal joint.
5. An arrangement according to any one preceding claim wherein there is a single steerable wheel.
6. An arrangement according to any one preceding claim wherein said axis is transverse or generally parallel to a longitudinal direction of travel of said hull.
7. An arrangement according to any one preceding claim wherein the steering mechanism continues to be able to turn the steering arm member and wheel when the wheel is in the retracted position.

8. An arrangement according to claim 7 wherein the steering arrangement is also connected to water guidance means which are operable when the wheel is in the retracted position.
- 5 9. An arrangement according to claim 8 wherein the water guidance means is a rudder or hydrojet.
10. An arrangement according to any one preceding claim wherein said pivot means includes a bracket on which said steerable leg member is mounted.
- 10 11. An amphibious vehicle having a wheel mounting and steering arrangement according to any one of preceding claims 1 to 10.
12. An amphibious vehicle according to claim 11 wherein shock absorbing properties are effected by a low-pressure tyre or additional suspension means.
- 15

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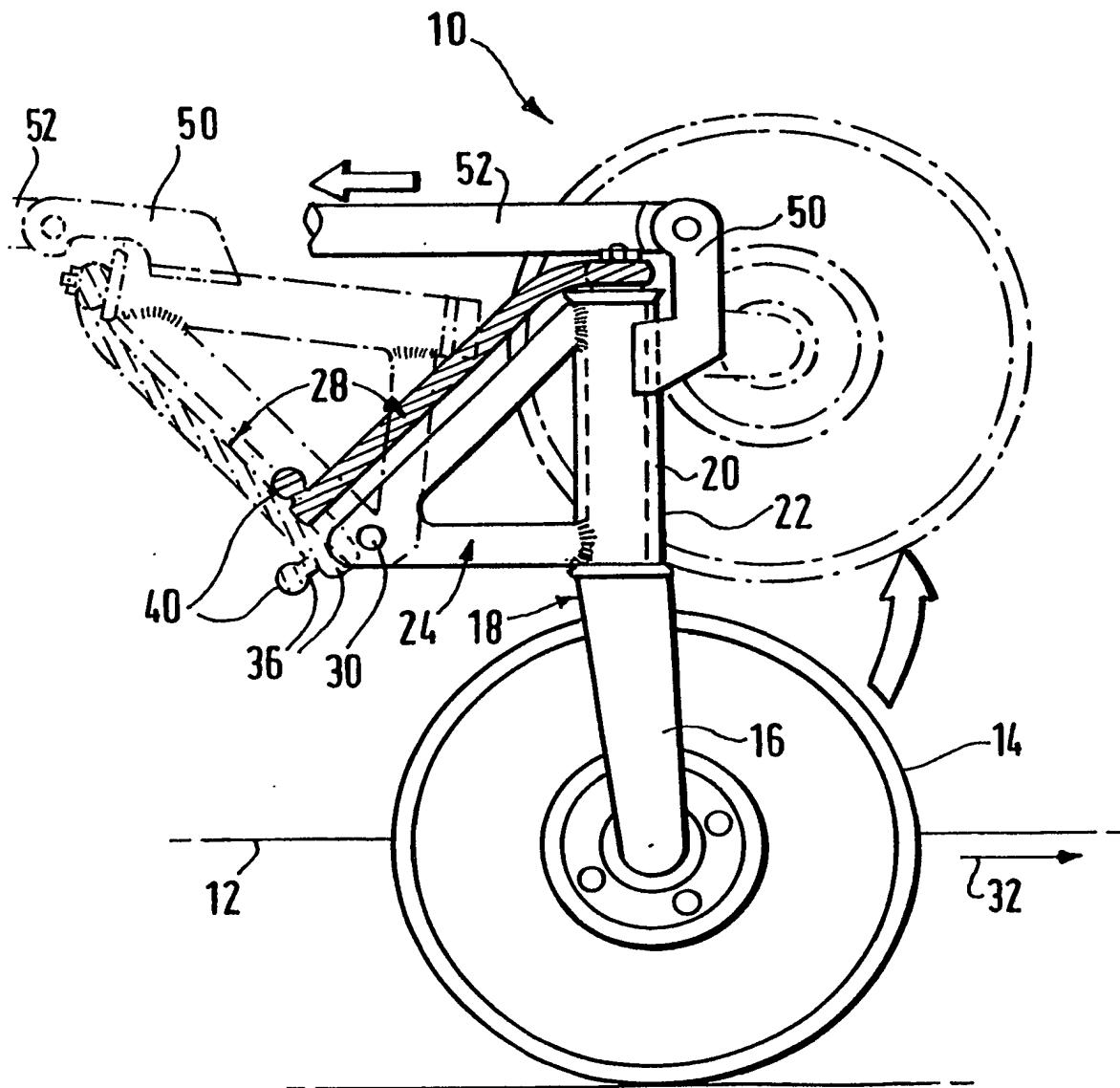


FIG.1.

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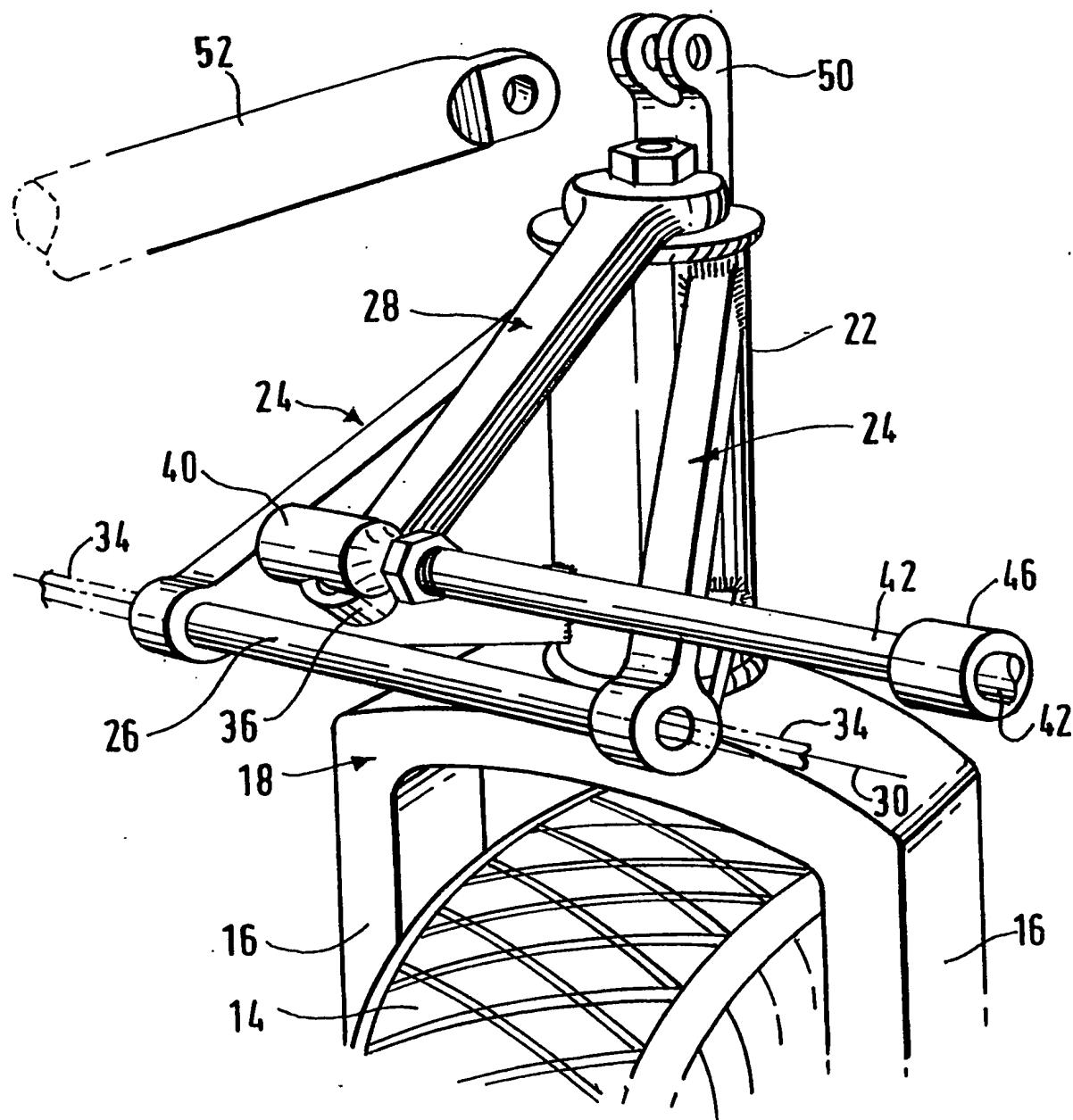


FIG.2.

## INTERNATIONAL SEARCH REPORT

PCT/GB 02/04588

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 B60F3/00 B63C13/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 B60F B63C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -	US 3 755 838 A (DUNAGAN L) 4 September 1973 (1973-09-04) the whole document ----	1,2,4-6, 10-12
X	US 3 421 472 A (OBERG HUGH E) 14 January 1969 (1969-01-14) the whole document ----	1-3,8-12
A	FR 2 322 759 A (PAGES MICHEL) 1 April 1977 (1977-04-01) -----	

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the International filing date
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- "P" document published prior to the International filing date but later than the priority date claimed

- "T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

PCT/GB 02/04588

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 3755838	A	04-09-1973	NONE			
US 3421472	A	14-01-1969	NONE			
FR 2322759	A	01-04-1977	FR	2322759 A1		01-04-1977